



GLOBE Carbon Cycle: Investigating the Carbon Cycle in Terrestrial Ecosystems

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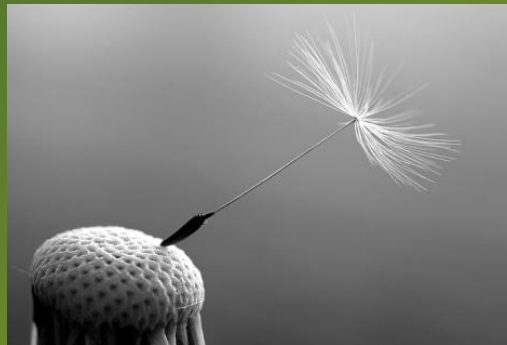
GLOBE Program Office: Gary Randolph



Carbon



- The most abundant element in living things
- Accounts for 45-50% of the total mass of the biosphere.
- Also present in the Earth's, atmosphere, soil, oceans, and crust
- Important greenhouse gas



South Africa: Eskom Promises Cleaner Energy

Changes in rainfall man-made, Canadian scientists say

Last Updated: Monday, July 23, 2007 | 4:05 PM ET
[CBC News](#)

Global Warming Threatens Coffee Collapse in Uganda

Alexis Okeowo in Nsangi, Uganda
for [National Geographic News](#)
July 24, 2007

Teenagers support 'green' schools

2007 seen as second warmest year as climate shifts

Fri Jun 29, 2007 3:54 PM IST

UN issues desertification warning

Tibet warming at record rate

Posted Mon Jul 23, 2007 5:42am AEST

Tuesday, July 24, 2007

U.S. governors address climate change

Updated Sun. Jul. 22 2007 2:57 PM ET

Flooding in England: What can be done?

China releases strategy to counter climate change

Nation's plan aims to improve energy efficiency by 20% by 2010

Global warming may uproot millions

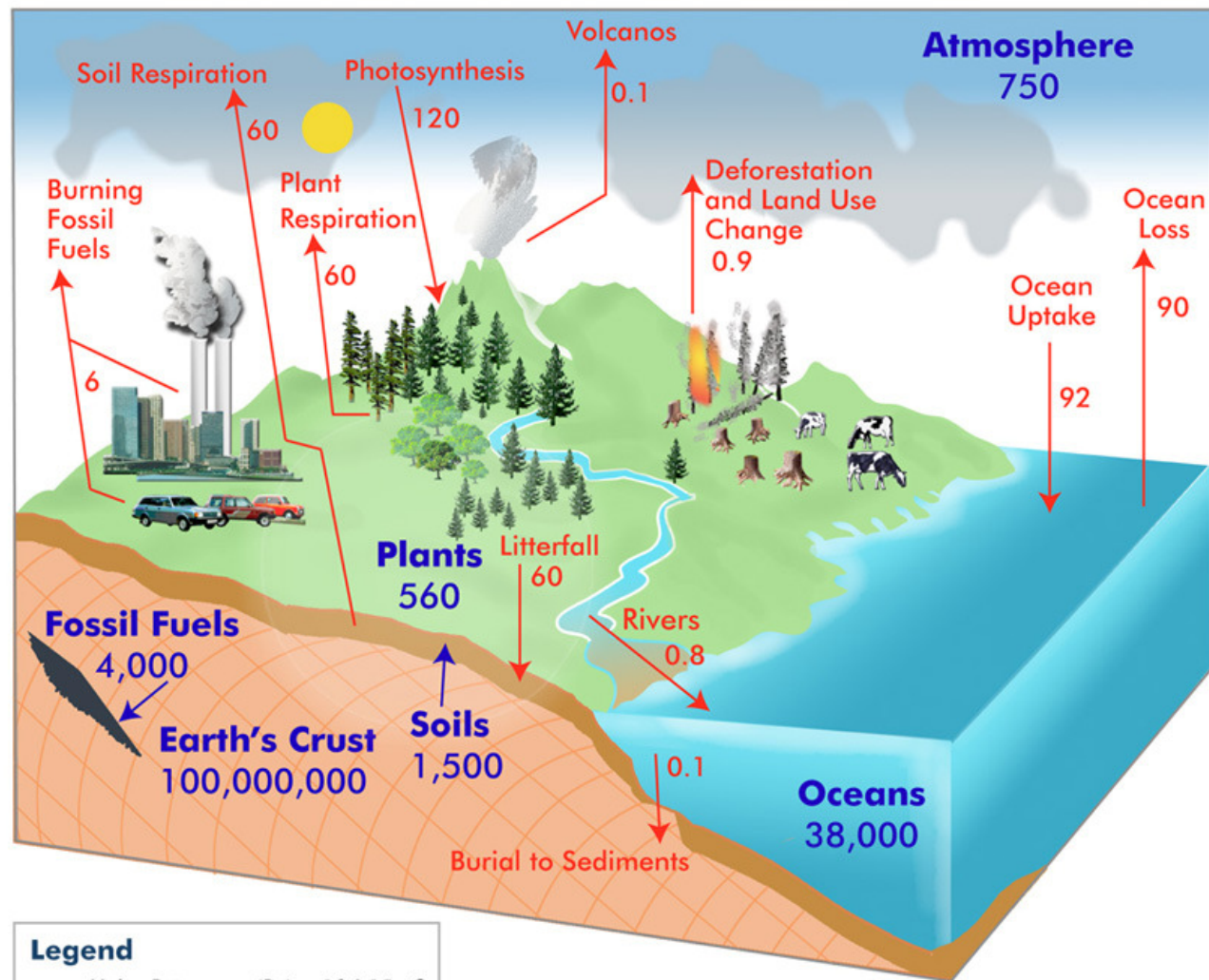
In the coming decades, the effects of global warming are likely to turn millions into refugees.

Carbon trading market opens in Melbourne

Posted Mon Jul 23, 2007 11:24am AEST

The Carbon Cycle

Global Carbon Cycle



Legend

Units: Petagrams (Pg) = 10^{15} gC

- Pools: Pg
- Fluxes: Pg/year



Carbon Cycle Project Goals

Students will...

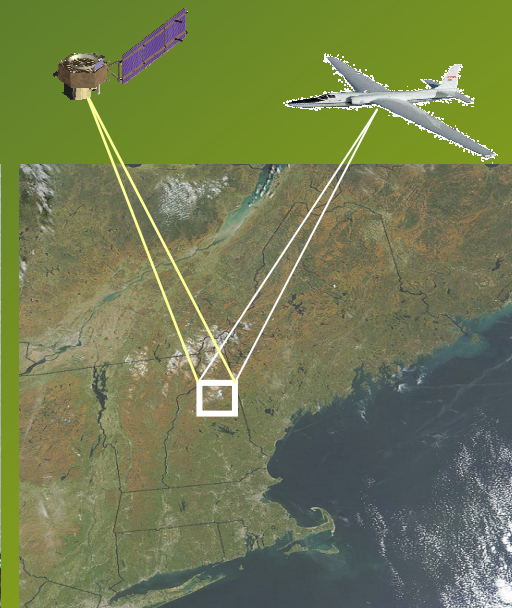
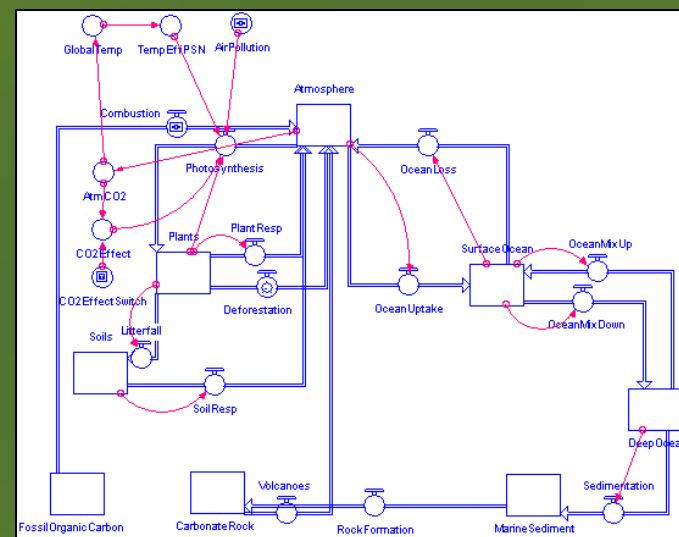
- **Learn why carbon is an important element in ecosystems, and how it cycles through ecosystems.**
- **Gain skills in current carbon cycle research techniques.**
- **Increase their ability to critically think about problems.**
- **Understand the nature of science research.**



Carbon Cycle Activities to Meet Goals

4 Major Categories:

- Modeling
- Classroom Experiments
- Field Measurements
- Remote Sensing Toolkit





Modeling

- *Introduces students to the use of models in science*
- *Applicable to students around the world*
- *Learn how carbon is stored and transferred at the ecosystem and global level*
- *Understand ways that carbon can change with a change in environmental conditions*
- *Connection to field collected data*



Modeling - software

www.iseesystems.com/

Introduction

June 13-15, 2007
Singapore

June 25-27, 2007
Meriden, NH

Online Training

"Model Building I" recorded
webinar series now available

Sharpen your skills with
"Building More Effective
Models" recorded series

Latest News

isee systems Partners with
Forio to Offer Online
Simulation Sharing

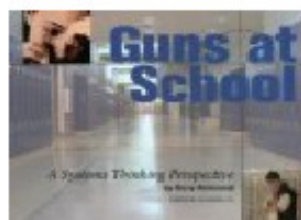
Webinar

"Making Your Simulations
Run on the Web"
Download Recording

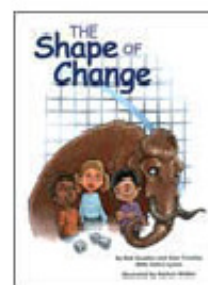
Recent Releases

V9.0.2 Now Available
V9.0.1 Enhancements
Version 9 New Features

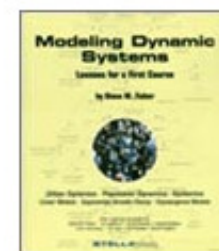
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Engage students in
Systems Thinking with
classroom-ready
lessons.



Diana Fisher's
Modeling book offers
a beginner's course.

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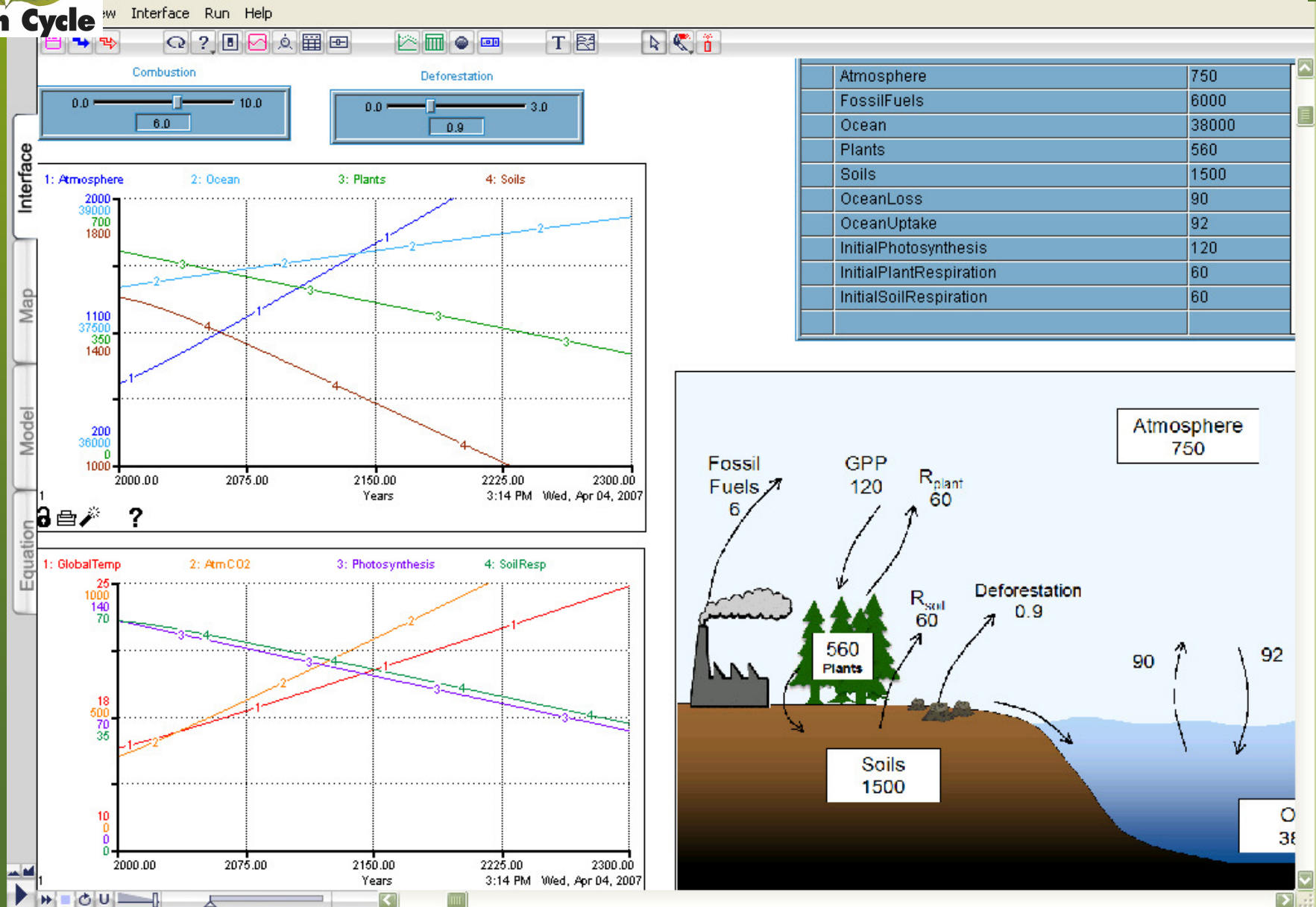
The new Version 9 isee Player lets you view
and share *iThink* and *STELLA* models for FREE.
(updated 2/21/2007)
Download your copy today!

GLOBE



Carbon Cycle

Modeling - model development





Modeling - accompanying materials

- iSee Player Tutorial
- Modeling activity sequence
- Student questions to accompany models



iSee Player Tutorial

Using the Forest Biomass Accumulation Model as an Example

The iSee player is the free viewer for models created in STELLA. It opens files with the extension .STM

Tutorial Developed by: **GLOBE Carbon Cycle** ¹ (www.globe.gov/carboncycle)

Come check out our poster or Friday workshop to find out more!



Classroom Experiments: Plant-a-Plant

- *Hands-on activities: range of cultivation experiments with real plants*
- *Exploration and validation of variables necessary for plant growth*
- *Demonstrates that CO₂ is incorporated into plant biomass*
- *Understand changes in carbon storage at the plant and ecosystem level*

Plant-a-Plant - greenhouse testing

Preconditions of the experimental:

1. Selected plant species should be available worldwide
2. Experiments duration should be classroom appropriate
3. Low cost, high availability materials



Plant-a-Plant - teachers & students



Manuals and worksheets for teachers and students are under preparation - an early version was presented at the Teacher Think Tank in Prague 24th-25th March 2007

In the spring one classroom had the opportunity to test the new activities!

Come check out our poster and Thursday presentation!



Field Measurements

- *Designed similarly to existing GLOBE protocols*
 - *Comparison of measurements between schools*
- *Allow students to make connections between the global C cycle and their own schoolyard*
- *Potential to use as inputs to some of the models*
- *To be used in conjunction with the remote sensing toolkit*

Instructions

Notes on collecting data with students

HARDWOOD Species (use this page if there is not a sheet specific to your species)

This equation from Ribe 1973 is in the form: $\text{LOGwt} = a + b * \text{Log dbh}$, where wt is in gm and dbh is in inches

Enter measured tree circumference in the blue column

Tree Tag #	Tree Species	Circumference (cm)	DBH(in)	Bole	Branch	Foliage	Total Biomass
101	Sugar Maple	43.5	5.45	57.68	4.64	2.24	64.56
102	Shagbark Hickory	102.9	12.90	560.81	19.58	10.04	590.44
103	Shagbark Hickory	74	9.27	234.74	11.29	5.65	251.67
104	Shagbark Hickory	104.6	13.11	585.62	20.12	10.34	616.08
105	Sugar Maple	65.9	8.26	172.82	9.30	4.62	186.73
106	Beech	79.8	10.00	286.52	12.80	6.45	305.77
109	Sugar Maple	36.3	4.55	35.77	3.43	1.63	40.83
111	Black/River Birch	30.2	3.78	22.00	2.52	1.18	25.71
112	Sugar Maple	52.9	6.63	96.72	6.44	3.15	106.30
113	Bech	55	6.89	107.19	6.87	3.37	117.43
114	Sugar Maple	29.9	3.75	21.43	2.48	1.16	25.07
115	Sugar Maple	38.1	4.77	40.64	3.72	1.77	46.14
116	Shagbark Hickory	98	12.28	493.00	18.05	9.22	520.27
117	Sugar Maple	31.7	3.97	25.00	2.74	1.29	29.03
# N/A	# N/A			Musclewood	Carpinus carolinia	CACA	
# N/A	# N/A			Ironwood	Ostrya virginiana	OSVI	
# N/A	# N/A			Basswood	Tilia americana	TIAM	
# N/A	# N/A			Sweet Birch	Betula lenta	BELE	
# N/A	# N/A			Eastern White Pine	Pinus strobus	PIST	
# N/A	# N/A			Eastern Hemlock	Tsuga canadensis	TSCA	
# N/A	# N/A						



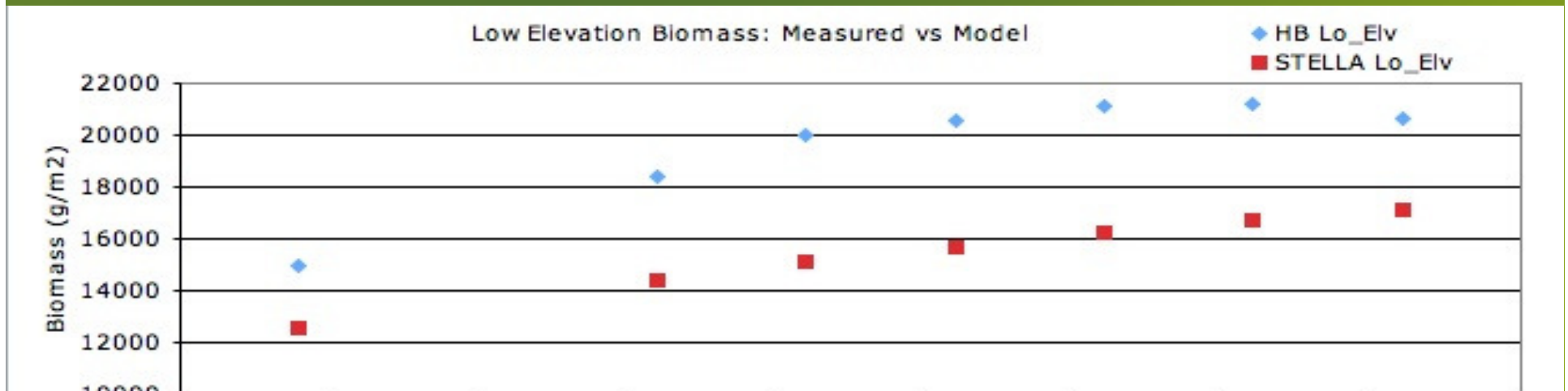
Remote Sensing Toolkit - coming soon

- *Learn the nature of remote sensing and satellite imagery as a tool for looking at the world*
- *Understand how scientists use maps and satellite images to estimate global carbon storage*
- *Use remotely sensed images for specific investigations*
 - *Comparison between locations*
 - *Relationship to field measurements*
 - *Change in the landscape over time*



Data & Model Integration

- Part of an under construction Earth Exploration Toolbook chapter
- Download and manipulate measured data from the Hubbard Brook Experimental Forest and the Foliar Chemistry Database
- Use some data to make STELLA model runs
- Compare how well the model predicts measured data



UNH Think Tanks

February 5th, 2007

April 6th, 2007

May School Visits

**Czech Republic
Teachers' Think Tank
Workshop**

GLOBE Games – Czech Republic

EET AccessData
Workshop

May, 2007

New Hampshire
Science Teacher Association
March, 2007

Europe Regional
Meeting – Budapest



UNH Summer Workshop
August 17&21, 2007

Czech Fall Workshop



Website: Updates and Information

www.globe.gov/carbon_cycle

The screenshot shows the website's header with language options: English, Español, Français, Русский, اللغة العربية, Deutsch, Nederlands. The main navigation bar includes 'Home', 'Projects', 'For Students', 'For Teachers', 'For Scientists', and 'For Partners'. The central content area features two large images: on the left, a sun and leaves with the text 'Investigating the Carbon Cycle in Terrestrial Ecosystems'; on the right, a tree trunk cross-section with the text 'Carbon Cycle'. Below these images is the quote '"Carbon: the building block of life."' and a paragraph explaining carbon's role in ecosystems. A sidebar on the right contains links for more information on the Carbon Cycle Project.

English Español Français Русский اللغة العربية Deutsch Nederlands

The GLOBE Program [Log in](#)

Home Projects For Students For Teachers For Scientists For Partners


Investigating the Carbon Cycle in Terrestrial Ecosystems


Carbon Cycle

"Carbon: the building block of life."

You may have heard this phrase, but have you understood what it really means? Carbon is the most abundant element in living things and accounts for approximately 50% of the total mass of plants and animals. Carbon is also present in Earth's atmosphere, soils, oceans and crust, and cycles between these components on varying time and spatial scales.

Find out more on the Carbon Cycle Project:
[Project summary](#) (PDF)
[Carbon Cycle FAQs](#)
[Czech collaboration](#)
[Carbon cycle diagram](#)

Email: globecarboncycle@globe.gov